Atmospheric Photochemistry Studies of Pollutant Emissions from Transportation Vehicles Operating on Alternative Fuels

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Subcontract Number

XAP-3-11153-01

Performance Period

9/93–9/95

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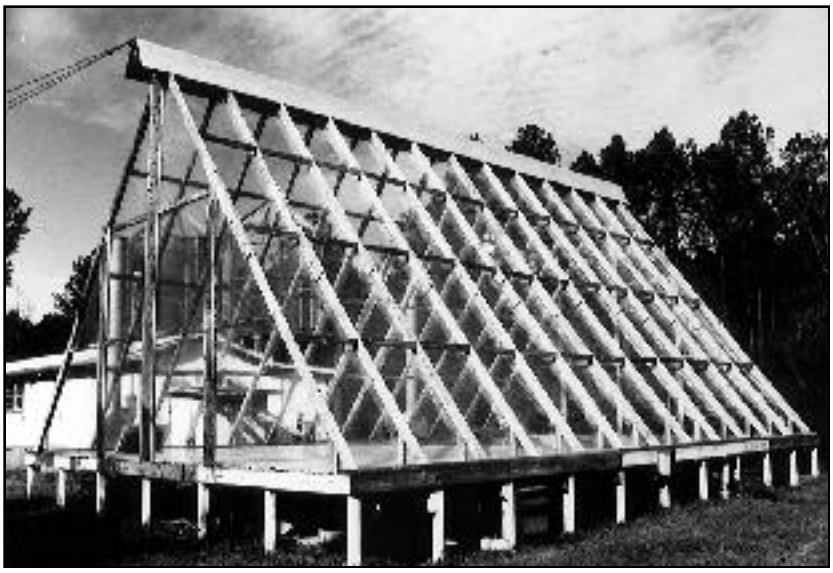
Objective

To improve our ability to predict the changes in urban ozone (O_3) that result from the widespread use of alternative fuels in automobiles. The entire range of fuels—alcohol fuels, natural gas fuels, and reformulated gasoline (RFG)—is of interest.

Approach

The smog chamber is a chemical environment designed to simulate the complex volatile organic compound (VOC) compositions of urban atmospheres. We conducted outdoor smog chamber experiments using complex VOC mixtures that arise from the use of blended ethanol (EtOH), compressed natural gas (CNG), and liquefied petroleum gas (LPG) as vehicle fuels. Advanced analytical methods are used to identify and quantify previously unknown or undetected reaction products. These results will then be used to test and improve the formulations of our current photochemical reaction mechanisms, and with Urban Airshed Model (UAM) simulations, to help answer questions concerning the effect of urban O_3 from the use of alternative fuels.



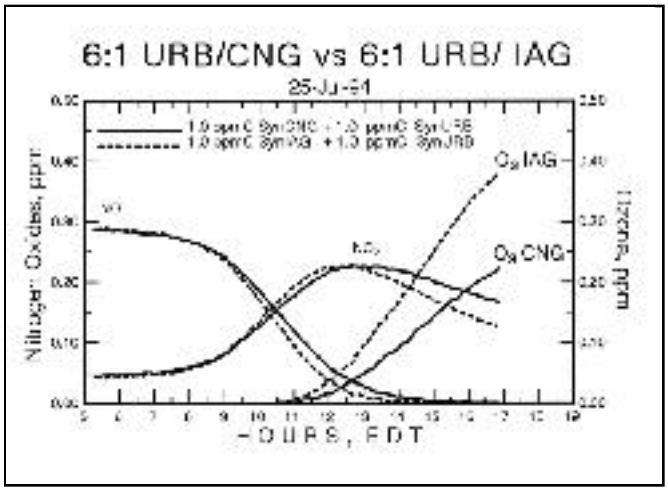
The University of North Carolina outdoor smog chamber

Accomplishments

Twenty-five smog chamber experiments were conducted for this study. Results indicate a substantial benefit from the use of CNG and LPG in a synthetic urban air mixture (SynURB) background. EtOH use did not result in an ozone reduction. Under some conditions, it increased ozone production. We also reformulated a commonly used airshed reaction mechanism to fit the chamber observations more accurately, and used this improved mechanism in UAM simulations of air quality under alternative fuel use scenarios.

Future Direction

A final report is expected to be published by February 1997.



Smog chamber results comparing ozone (O_3) formation from natural gas and from Industry Average Gasoline (IAG)

Publications

Borbridge, L. 1995. "ADual Derivatization Technique for the Determination of Unsaturated and Epoxy-Carbonyls in Air Using Gas Chromatography/Mass Spectrometry." University of North Carolina, August.

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Lo, C.Y.S. 1995. "Process Composition Analysis of Urban Airshed Model Predictions." University of North Carolina, August.

Rigsbee, C. 1995. "The Hydroxy Radical Initiated Oxidation of C2-C4 Olefins: Detection of Carbonyl Compounds." University of North Carolina, August.

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